CLAIMS

1. A method for detecting a presence of a characteristic in an object, the method comprising the steps of:
providing at least three detection technologies;

first determining, utilizing one of the at least three detection technologies, whether the characteristic is present in the object;

subsequently determining, utilizing a subsequent one of the at least three detection technologies, whether the characteristic is present in the object;

finally determining utilizing another one of the at least three detection technologies, if previous determinations for a majority of said at least three detection technologies are not identical, whether the characteristic is present in the object;

applying a predetermined criterion, after determinations by at least a majority of the at least three detection technologies, to detect the presence of the characteristic in the object.

2. The method of claim 1 wherein the characteristic is an undesired substance within the object.

3. The method of claim 1 wherein said at least three detection technologies comprise an odd number of detection technologies; and,
wherein the predetermined criterion comprises detecting presence of the characteristic if a majority of said at

least three detection technologies utilized determines that the characteristic is present in the object.

4. The method of claim 1 wherein said at least three detection technologies comprise three detection technologies; and, wherein,

P_{D1} is a probability of detection of the technology that has a highest probability of detection,

P_{D2} is a probability of detection of a second one of the three detection technologies,

P_{D3} is a probability of detection of a third one of the three detection technologies, and,

the probability of detection of the technology that has the highest probability of detection satisfies the following relation:

$$(1- P_{D1}) \geq [(1- P_{D1})(1- P_{D2}) + (1- P_{D1})P_{D2}(1- P_{D3}) + P_{D1}(1- P_{D2})(1- P_{D3})].$$

5. The method of claim 1 wherein said at least three detection technologies comprise three detection technologies; and, wherein,

P_{FA1} is a probability of false alarm of the technology that has a lowest probability of false alarm;

P_{FA2} is a probability of false alarm of a second one of the three detection technologies; and

P_{FA3} is a probability of false alarm of a third one of the three detection technologies; and,

the probability of false alarm of the technology that has the lowest probability of false alarm satisfies the following relation:

$P_{FA1} \geq [\ (P_{FA1})(P_{FA2}) + (1 - P_{FA1})(P_{FA2})(P_{FA3})$
$+ (P_{FA1})(1 - P_{FA2})(P_{FA3})\ ].$

6. The method of claim 4 wherein,
P_{FA1} is a probability of false alarm of the technology that has a lowest probability of false alarm;
P_{FA2} is a probability of false alarm of a second one of the three detection technologies; and
P_{FA3} is a probability of false alarm of a third one of the three detection technologies; and,
the probability of false alarm of the technology that the lowest probability of false alarm satisfies the following relation:
$P_{FA1} \geq [\ (P_{FA1})(P_{FA2}) + (1 - P_{FA1})(P_{FA2})(P_{FA3})$
$+ (P_{FA1})(1 - P_{FA2})(P_{FA3})\ ].$

7. The method of claim 2 wherein the undesired substance comprises an explosive.

8. The method of claim 7 wherein each one of said at least three detection technologies utilizes a technology selected from the group consisting of X-ray technologies, Neutron-Based Bulk Explosives Detection Technologies, Nuclear non-neutron based Bulk Explosive Technologies, Nuclear Quadrupole Resonance Technologies, and Trace Detection Technologies.

9. A method for selecting sub-systems for integration into a system, the method comprising the steps of:
(a) providing a candidate system comprising at least two detection sub-systems;

(b) performing a Monte Carlo analysis of detecting a presence of the at least one characteristic in an object;

(c) calculating a pre-defined figure of merit for the candidate system;

(d) selecting the candidate system if the figure of merit value satisfies a pre-determined criterion.

10. The method of claim 9 wherein the at least one characteristic is at least one undesired substance within the object.

11. The method of claim 10 wherein the at least one undesired substance comprises at least one explosive.

12. The method of claim 11 wherein each one of said at least two detection sub-systems utilizes a technology selected from the group consisting of X-ray technologies, Neutron-Based Bulk Explosives Detection Technologies, Nuclear non-neutron based Bulk Explosive Technologies, Nuclear Quadrupole Resonance Technologies, and Trace Detection Technologies.

13. The method of claim 11 wherein the at least one explosive comprises two explosives of different type.

14. A system for detecting presence of a characteristic in an object, the system comprising:

three detection sub-systems; and, wherein,

P_{D1} is a probability of detection of a sub-system that has a highest probability of detection,

P_{D2} is a probability of detection of a second one of the three detection sub-systems,

P_{D3} is a probability of detection of a third one of the three detection sub-systems, and,

the probability of detection of the sub-system that has the highest probability of detection satisfies the following relation:

$$(1- P_{D1}) \geq [(1- P_{D1})(1- P_{D2}) + (1- P_{D1})P_{D2}(1- P_{D3}) + P_{D1}(1- P_{D2})(1- P_{D3})].$$

15. A system for detecting presence of a characteristic in an object, the system comprising:

three detection sub-systems; and, wherein,

P_{FA1} is a probability of false alarm of a sub-system that has a lowest probability of false alarm,

P_{FA2} is a probability of false alarm of a second one of the three detection sub-systems, and

P_{FA3} is a probability of false alarm of a third one of the three detection sub-systems, and,

the probability of false alarm of the sub-system that has the lowest probability of false alarm satisfies the following relation:

$$P_{FA1} \geq [(P_{FA1})(P_{FA2}) + (1 - P_{FA1})(P_{FA2})(P_{FA3}) + (P_{FA1})(1 - P_{FA2})(P_{FA3})].$$

16. The system of claim 14 wherein,

P_{FA1} is a probability of false alarm of the sub-system that has a lowest probability of false alarm,

P_{FA2} is a probability of false alarm of a second one of the three detection sub-systems, and

P_{FA3} is a probability of false alarm of a third one of the three detection sub-systems, and,

the probability of false alarm of the sub-system that has the lowest probability of false alarm satisfies the following relation:

$$P_{FA1} \geq [(P_{FA1})(P_{FA2}) + (1 - P_{FA1})(P_{FA2})(P_{FA3}) + (P_{FA1})(1 - P_{FA2})(P_{FA3})].$$

17. The system of claim 14 wherein the characteristic is an undesired substance within the object.

18. The system of claim 17 wherein the undesired substance comprises an explosive.

19. The system of claim 18 wherein each one of said three detection sub-systems utilizes a technology selected from the group consisting of X-ray technologies, Neutron-Based Bulk Explosives Detection Technologies, Nuclear non-neutron based Bulk Explosive Technologies, Nuclear Quadrupole Resonance Technologies, and Trace Detection Technologies.

20. The system of claim 15 wherein the characteristic is an undesired substance within the object.

21. The system of claim 20 wherein the undesired substance comprises an explosive.

22. The system of claim 21 wherein each one of said three detection sub-systems utilizes a technology selected from the group consisting of X-ray technologies, Neutron-Based Bulk Explosives Detection Technologies, Nuclear non-neutron

based Bulk Explosive Technologies, Nuclear Quadrupole Resonance Technologies, and Trace Detection Technologies.

23. A system for detecting presence of at least one characteristic in an object, the system comprising:
at least two detection sub-systems;
said at least two detection sub-systems being selected by the steps of:
(a) providing a candidate system from at least two candidate systems, each candidate system from said at least two candidate systems comprising at least two detection sub-systems;
(b) performing a Monte Carlo analysis of detecting a presence of the at least one characteristic in an object for the candidate system;
(c) calculating a pre-defined figure of merit for the candidate system;
(d) providing another candidate system from said at least two candidate systems;
(e) repeating steps (a) through (c) for the another candidate system;
(f) selecting a system from said at least two candidate systems, said selected system having a figure of merit value satisfying a pre-determined criterion.

24. The system of claim 23 wherein the at least one characteristic is at least one undesired substance within the object.

25. The system of claim 24 wherein the at least one undesired substance comprises at least one type of explosive.

26. The system of claim 25 wherein each one of said at least two detection sub-systems utilizes a technology selected from the group consisting of X-ray technologies, Neutron-Based Bulk Explosives Detection Technologies, Nuclear non-neutron based Bulk Explosive Technologies, Nuclear Quadrupole Resonance Technologies, and Trace Detection Technologies.

27. The system of claim 25 wherein the at least one explosive comprises two types of explosives.

28. The method of claim 9 wherein said at least two detection sub-systems comprise three detection sub-systems; and, wherein,

P_{D1} is a probability of detection of the sub-system that has a highest probability of detection,

P_{D2} is a probability of detection of a second one of the three detection sub-systems,

P_{D3} is a probability of detection of a third one of the three detection sub-systems, and,

the probability of detection of the sub-system that has the highest probability of detection satisfies the following relation:

$$(1- P_{D1}) \geq [(1- P_{D1})(1- P_{D2}) + (1- P_{D1})P_{D2}(1- P_{D3}) + P_{D1}(1- P_{D2})(1- P_{D3})].$$

29. The method of claim 9 wherein said at least two detection sub-systems comprise three detection sub-systems; and, wherein,

P_{FA1} is a probability of false alarm of the sub-system that has a lowest probability of false alarm,

P_{FA2} is a probability of false alarm of a second one of the three detection sub-systems, and

P_{FA3} is a probability of false alarm of a third one of the three detection sub-systems, and,

the probability of false alarm of the sub-system that has the lowest probability of false alarm satisfies the following relation:

$$P_{FA1} \geq [(P_{FA1})(P_{FA2}) + (1 - P_{FA1})(P_{FA2})(P_{FA3}) + (P_{FA1})(1 - P_{FA2})(P_{FA3})].$$

30. The method of claim 9 further comprising the steps of:

(e) providing another candidate system comprising at least two detection sub-systems;

(f) repeating steps (a) through (d) for the another candidate system.

31. A system for detecting presence of at least one type of explosive in an object, the system comprising:

at least two explosive detection sub-systems;

said at least two explosive detection sub-systems being selected by the steps of:

(a) providing a candidate system from at least two candidate systems, each candidate system from said at least two candidate systems comprising at least two explosive detection sub-systems;

(b) performing a Monte Carlo analysis of detecting a presence of the at least one type of explosive in an object for the candidate system;

(c) calculating a pre-defined cost figure of merit for the candidate system;

(d) providing another candidate system from said at least two candidate systems;

(e) repeating steps (a) through (c) for the another candidate system;

(f) selecting a system from said at least two candidate systems, said selected system having a cost figure of merit value satisfying a pre-determined criterion.

32. The system of claim 31 wherein said at least two detection sub-systems comprise three explosive detection sub-systems; and, wherein,

P_{D1} is a probability of detection of the explosive detection sub-system that has a highest probability of detection;

P_{D2} is a probability of detection of a second one of the three explosive detection sub-systems;

P_{D3} is a probability of detection of a third one of the three explosive detection sub-systems; and,

the probability of detection of the explosive detection sub-system that has the highest probability of detection satisfies the following relation:

$$(1- P_{D1}) \geq [(1- P_{D1})(1- P_{D2}) + (1- P_{D1})P_{D2}(1- P_{D3}) + P_{D1}(1- P_{D2})(1- P_{D3})].$$

33. The system of claim 31 wherein said at least two explosive detection sub-systems comprise three explosive detection sub-systems; and, wherein,

P_{FA1} is a probability of false alarm of the explosive detection sub-system that has a lowest probability of false alarm,

P_{FA2} is a probability of false alarm of a second one of the three explosive detection sub-systems, and

P_{FA3} is a probability of false alarm of a third one of the three explosive detection sub-systems, and,
the probability of false alarm of the explosive detection sub-system that has the lowest probability of false alarm satisfies the following relation:

$$P_{FA1} \geq [\ (P_{FA1})(P_{FA2}) + (1 - P_{FA1})(P_{FA2})(P_{FA3}) + (P_{FA1})(1 - P_{FA2})(P_{FA3})].$$